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A COMPARISON OF THE CŒUR D'ALENE MONZONITE WITH OTHER PLUTONIC ROCKS OF IDAHO

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The rough mountainous area comprising nearly all of the central part of Idaho and adjacent portions of Montana is an enormous batholith of quartz-monzonite of late Mesozoic age. In the northern part or "panhandle" of the state the predominating Algonkian sediments are cut by irregular masses of acidic intrusives which are quite generally believed to be outliers of the great batholith to the south. It is the purpose of this paper to point out that among these intrusives of northern Idaho is a type distinctly different from the other acidic intrusives of the state, and to propound for future field-workers the problem of its relationship to them.

The quartz-monzonites of central Idaho and those found in the southern part of the state are light-gray, granular rocks with biotite the chief dark silicate, and often containing muscovite. Porphyritic development of the feldspar and variations in the relative amounts of the minerals are common, but taken as a whole they are remarkably uniform rocks. I have seen this quartz-monzonite in place in the vicinity of Moscow, of Elk City, and in the Dixie mining district, and have examined specimens of it from other localities, and in every case it showed the same general characters. Professor D. C. Livingston has traversed great areas of it along the Salmon River; and the various United States Geological Survey reports by Lindgren, Eldridge, and Umpleby all describe the same light-gray, *micaceous* quartz-monzonite of which some of us have come to speak familiarly as the "Idaho granite." In the extreme north of the state around Priest Lake I have crossed many miles of the same rock.

Indeed it would be difficult in a pile of mixed specimens from these localities to distinguish the rocks from the various districts. Should there be in this pile, however, a sample of the average intrusive from the Cœur d'Alene district, the most casual observer would note a difference. This rock, according to Calkins,[1] is

> a medium-grained granular rock of which the constituents megascopically recognizable are feldspar, hornblende, and a little quartz. Of the feldspars, striated plagioclase, opaque and white, in rather small idiomorphic crystals can be distinguished from somewhat larger, grayish, and more transparent imperfectly formed crystals of alkali feldspar. The two are present in nearly equal amounts. The microscope shows, in addition to the constituents named, a little biotite, some small prisms of light-green monoclinic pyroxene with titanite and magnetite as abundant accessories.

Variations from this type are noted, especially in respect to the relative amounts of the minerals, but none of them resembles the rock from central Idaho, from which all of the Cœur d'Alene monzonite differs in the smaller amount of quartz, in the presence of hornblende, and in the lack of megascopic mica. The chemical differences are indicated by Table I.

TABLE I

ANALYSES OF INTRUSIVE ROCKS FROM IDAHO

	A	B	C	D	E
SiO_2	61.41	72.07	68.42	69.56	65.23
Al_2O_3	17.99	15.51	15.01	15.29	16.94
Fe_2O_3	2.93	0.31	0.97	0.86	1.60
FeO	1.39	1.01	1.93	2.06	1.91
MgO	1.30	0.35	1.21	0.69	1.31
CaO	4.75	1.93	2.60	2.81	3.85
Na_2O	4.01	4.02	3.23	3.97	3.57
K_2O	4.59	4.09	4.25	3.36	3.02
H_2O-	0.11	0.03	0.54	....	0.18
H_2O+	0.68	0.30	0.73	0.86	0.88
TiO_2	0.53	0.16	0.50	0.55	0.66
P_2O_5	0.19	0.11	0.13	0.16	0.19
All other	0.46	....	0.38	....	0.44
Total	100.24	99.89	99.95	100.17	99.78

A. Quartz-monzonite, near Gem, Idaho (Cœur d'Alene).—*Prof. Paper 62, U.S. Geol. Survey*, p. 47.
B. Quartz-monzonite, Mill Creek, Mont.—Lindgren, *Prof. Paper 27, U.S. Geol. Survey*, p. 18.
C. Quartz-monzonite, Hailey, Idaho.—Lindgren, *20th Ann. Rept., U.S. Geol. Survey*, p. 81.
D. Granite, Shafer Butte, Boise Co., Idaho.—Lindgren, *loc. cit.*
E. Biotite granite, Willow Creek Dist., Boise Co., Idaho.—Lindgren, *18th Ann. Rept., U.S. Geol. Survey*, p. 40.

The magmatic symbols for these rocks are as follows (calculation of A by Calkins, *loc. cit.*, and of C, D, and E by Washington, *Prof. Paper 14, U.S. Geol. Survey*):

A = I · 5 · 2 · 3, pulaskose.
B = I · 4 · 2 · 3, toscanose.
C = I · 4 · 2 · 3, toscanose.
D = I · 4 · 2 · 4, lassenose.
E = I · 4 · 3 · 4, yellowstonose.

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[1] *Prof. Paper 62, U.S. Geol. Survey*, pp. 46–47.

The Cœur d'Alene rock, therefore, falls in a separate order, emphasizing its smaller quartz content. The striking difference in the habit of the ferromagnesian constituents is, of course, not shown by the quantitative classification. Rock of the Cœur d'Alene type is known also from the following localities:

1. On Vermillion Creek in Montana, where Calkins[1] found a rock "distinctly different from the intrusive masses to the west, and showing marked affinity with the masses of monzonite and syenite exposed to the southwest in the Cœur d'Alene district." The ferromagnesian mineral is either aegirine-augite or masses of hornblende and biotite pseudomorphic after pyroxene.

2. At the junction of Black Prince Creek with the St. Joe River where Pardee[2] found "a porphyritic monzonite" of "marked resemblance to the dominant rock in the intrusions of the Cœur d'Alene." Biotite, in addition to the distinctive hornblende, is reported to occur in this rock, but the quartz is in rather small amount.

3. On Gold Hill in the northern part of Latah County I have found a porphyritic, hornblendic monzonite that can in no way be distinguished from specimens from the Cœur d'Alene. Only twenty miles south of this locality are the Thatuna Hills, composed of the micaceous, quartzitic monzonite described as characteristic of the great batholith of central Idaho. In fact, it was the striking difference between the rocks from these two places that first called my attention to this problem. Unfortunately the intervening country is covered by Tertiary basalt, so the relationship between the rocks cannot be determined.

The other intrusives in northern Idaho, although showing considerable variation from the central Idaho type, nowhere, as far as I can learn, resemble this characteristic hornblende monzonite, and in most places they show marked affinities with the central Idaho type.

Reference to the map (Fig. 1) shows that the occurrences of the Cœur d'Alene type all fall in the northeast-southwest line that has already been noted by Calkins for the Cœur d'Alene and Vermillion

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[1] *Bull. 384, U.S. Geol. Survey*, p. 47.

[2] *Bull. 470, U.S. Geol. Survey*, Pt. I, p. 46.

Creek outcrops. When, in addition to this striking linear arrangement, we consider the fact that nowhere throughout the other extensive areas of Idaho acidic intrusives as described by Lindgren,

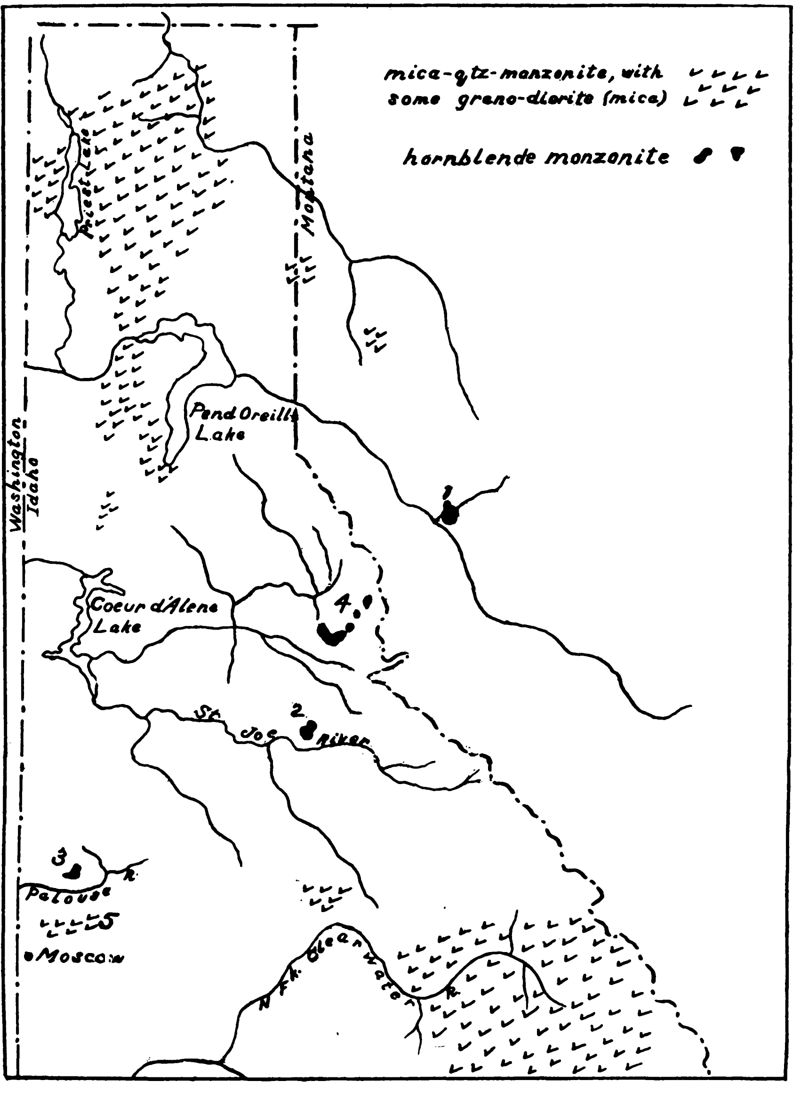

FIG. 1.—Acidic intrusives in Northern Idaho: 1, Vermillion Creek, Montana; 2, Black Prince Creek; 3, Gold Hill; 4, Cœur d'Alene District; 5, Thatuna Hills.

Calkins, Eldridge, and Umpleby, or where seen by Professor Livingston or the writer, is there any rock like this Cœur d'Alene type, it seems evident that we are dealing with something more significant than a single vast batholith underlying all of the state.

It is of course possible that the main Idaho batholith does underlie the Cœur d'Alene and neighboring districts at great depths, and that the exposures of the Cœur d'Alene type are offshoots reaching up into the overlying sediments and slightly differentiated. In view, however, of the proximity and nearly equal elevation of the Gold Hill and Thatuna Hills occurrences, I am inclined to regard the Cœur d'Alene type as the result of a separate intrusion, connected indeed in ultimate origin with the main batholith, but nevertheless distinct from it. Very probably it should be classed as a complementary intrusive, somewhat later than the main mass but from the same source. If this be true, we may expect to find monzonite of the Cœur d'Alene type cutting the micaceous quartz-monzonite. Until such a discovery is made, we must hold the problem in abeyance, content with the fact that the Cœur d'Alene intrusives, and those northeast and southwest of them, are distinctly different from the average type of Idaho quartz-monzonite.